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Chapter One

Do we Need Philosophy?

Before we start, you may be tempted to ask, "Well, what of it?" Is it really necessary for us to bother about complicated questions of science and philosophy? To such a question, two replies are possible. If what is meant is: do we need to know about such things in order to go about our daily life, then the answer is evidently no. But if we wish to gain a rational understanding of the world in which we live, and the fundamental processes at work in nature, society and our own way of thinking, then matters appear in quite a different

light.

Strangely enough, everyone has a "philosophy." For a philosophy is a way of looking at the world. We all believe we know how to distinguish right from wrong, good from bad. These are, however, very complicated issues which have occupied the attention of the greatest minds in history. When confronted with the terrible fact of the existence of events like the fratricidal war in the former Yugoslavia, the re-emergence of mass unemployment, the slaughter in Rwanda, many people will confess that they do not comprehend such things, and will frequently resort to vague references to "human nature." But

what is this mysterious human nature which is seen as the source of all our ills, and is alleged to be eternally unchangeable? This is a profoundly philosophical question, to which not many would venture a reply, unless they were of a religious cast of mind, in which case they would say that God, in His wisdom, made us like that. Why anyone should worship a Being that played such tricks on His creations is another matter.

Those who stubbornly maintain that they have no philosophy are mistaken. Nature abhors a vacuum, it is said. Those who lack a coherently worked-out philosophical standpoint will inevitably

reflect the ideas and prejudices of the society and the milieu in which they live. That means, in the given context, that their heads will be full of the ideas they imbibe from the newspapers, television, pulpit and schoolroom, which faithfully reflect the interests and morality of existing capitalist society.

Most people usually succeed in muddling through life, until some great upheaval compels them to re-consider the kind of ideas and values they grew up with. The crisis of society forces them to question many things they took for granted. At such times, ideas which seemed remote suddenly become strikingly relevant. Anyone who wishes

to understand life, not as a meaningless series of accidents or an unthinking routine, must occupy themselves with philosophy, that is, with thought at a higher level than the immediate problems of everyday existence. Only by this means do we raise ourselves to a height where we begin to fulfil our potential as conscious human beings, willing and able to take control of our own destinies.

It is generally understood that anything worth while in life requires some effort. The study of philosophy, by its very nature, involves certain difficulties, because it deals with matters far removed from the world of ordinary

experience. Even the terminology used presents difficulties because words are used in a way which does not necessarily correspond to the common usage. But the same is true for any specialised subject, from engineering to psychology.

The second obstacle is more serious. In the last century, when Marx and Engels first published their writings on dialectical materialism, they could assume that many of their readers had at least a working knowledge of classical philosophy, including Hegel. Nowadays, it is not possible to make such an assumption. Philosophy no longer occupies the place it had before, since

the role of speculation about the nature of the universe and life has long since been occupied by the sciences. The possession of powerful radio telescopes and spacecraft renders guesses about the nature and extent of our solar system unnecessary. Even the mysteries of the human soul are being gradually laid bare by the progress of neurobiology and psychology.

The situation is far less satisfactory in the realm of the social sciences, mainly because the desire for accurate knowledge often decreases to the degree that science impinges on the powerful material interests which govern the lives of people. The great advances made by

Marx and Engels in the sphere of social and historical analysis and economics fall outside the scope of the present work. Suffice it to point out that, despite the sustained and frequently malicious attacks to which they were subjected from the beginning, the theories of Marxism in the social sphere have been the decisive factor in the development of modern social sciences. As for their vitality, this is testified to by the fact that the attacks not only continue, but tend to increase in intensity as time goes by.

In past ages, the development of science, which has always been closely linked to that of the productive forces, had not reached a sufficiently high level to

permit men and women to understand the world in which they lived. In the absence of scientific knowledge, or the material means of obtaining it, they were compelled to rely upon the one instrument they possessed that could help them to make sense of the world, and thus gain power over it—the human mind. The struggle to understand the world was closely identified with humankind's struggle to tear itself away from a merely animal level of existence, to gain mastery over the blind forces of nature, and to become free in the real, not legalistic, sense of the word. This struggle is a red thread running through the whole of human history.

Role of Religion

"Man is quite insane. He wouldn't know how to create a maggot, and he creates Gods by the dozen." (Montaigne.)

"All mythology overcomes and dominates and shapes the force of nature in the imagination and by the imagination; it therefore vanishes with the advent of real mastery over them." (Marx, Grundrisse, p. 110.)

Animals have no religion, and in the past it was said that this constituted the main difference between humans and "brutes." But that is just another way of saying that only humans possess consciousness in the full sense of the word. In recent

years, there has been a reaction against the idea of Man as a special and unique Creation. This is undoubtedly correct, in the sense that humans developed from animals, and, in many important respects, remain animals. Not only do we share many of the bodily functions with other animals, but the genetic difference between humans and chimpanzees is less than two percent. That is a crushing answer to the nonsense of the Creationists.

Recent research with bonobo chimpanzees has proven beyond doubt that the primates closest to humans are capable of a level of mental activity similar, in some respects, to that of a

human child. That is striking proof of the kinship between humans and the highest primates, but here the analogy begins to break down. Despite all the efforts of experimenters, captive bonobos have not been able to speak or fashion a stone tool remotely similar to the simplest implements created by early hominids. The two percent genetic difference between humans and chimpanzees marks the qualitative leap from the animal to the human. This was accomplished, not by a Creator, but by the development of the brain through manual labour.

The skill to make even the simplest stone tools involves a very high level of mental ability and abstract thought. The

ability to select the right sort of stone and reject others; the choice of the correct angle to strike a blow, and the use of precisely the right amount of force—these are highly complicated intellectual actions. They imply a degree of planning and foresight not found in even the most advanced primates.

However, the use and manufacture of stone tools was not the result of conscious planning, but was something forced upon man's remote ancestors by necessity. It was not consciousness that created humanity, but the necessary conditions of human existence which led to an enlarged brain, speech and culture, including religion.

The need to understand the world was closely linked to the need to survive. Those early hominids who discovered the use of stone scrapers in butchering dead animals with thick hides got a considerable advantage over those who were denied access to this rich supply of fats and proteins. Those who perfected their stone implements, and worked out where to find the best materials stood a better chance of survival than those who did not. With the development of technique came the development of the mind, and the need to explain the phenomena of nature which governed their lives. Over millions of years, through trial and error, our ancestors began to establish certain relations

between things. They began to make abstractions, that is, to generalise from experience and practice.

For centuries, the central question of philosophy has been the relation of thinking to being. Most people live their lives quite happily without even considering this problem. They think and act, talk and work, with not the slightest difficulty. Moreover, it would not occur to them to regard as incompatible the two most basic human activities, which are, in practice, inseparably linked. Even the most elementary action, if we exclude simple biologically determined reactions, demands a degree of thought. To a degree, this is true not only of

humans but also of animals, as a cat lying in wait for a mouse. In man, however, the kind of thought and planning has a qualitatively higher character than any of the mental activities of even the most advanced of the apes.

This fact is inseparably linked to the capacity for abstract thought, which enables humans to go far beyond the immediate situation given to us by our senses. We can envisage situations, not just in the past (animals also have memory, as a dog which cowers at the sight of a stick) but also the future. We can anticipate complex situations, plan, and thereby determine the outcome, and,

to some extent, determine our own destinies. Although we do not normally think about it, this represents a colossal conquest which sets humankind apart from the rest of nature. "What is distinctive of human reasoning," says Professor Gordon Childe, "is that it can go immensely farther from the actual present situation than any other animal's reasoning ever seems to get it." (What Happened in History, p. 19.) From this capacity springs all the manifold creations of civilisation, culture, art, music, literature, science, philosophy, religion. We also take for granted that all this does not drop from the skies, but is the product of millions of years of development.

The Greek philosopher Anaxagoras, in brilliant deduction, said that man's mental development depended upon the freeing of the hands. In his important article, *The Part Played by Labour in the Transition from Ape to Man*, Engels showed the exact way in which this transition was achieved. He proved that the upright stance, freeing of the hands for labour, the form of the hands, with the opposition of the thumb to the fingers, which allowed for clutching, were the physiological preconditions for toolmaking, which, in turn, was the main stimulus to the development of the brain. Speech itself, which is inseparable from thought, arose out of the demands of social production, the need to realise

complicated functions by means of co-operation. These theories of Engels have been strikingly confirmed by the most recent discoveries of palaeontology, which show that hominid apes appeared in Africa far earlier than previously thought, and that they had brains no bigger than those of a modern chimpanzee. That is to say, the development of the brain came after the production of tools, and as a result of it. Thus, it is not true that "In the beginning was the Word," but as the German poet Goethe proclaimed—"In the beginning was the Deed."

The ability to engage in abstract thought is inseparable from language. The

celebrated prehistorian Gordon Childe observes:

"Reasoning, and all that we call thinking, including the chimpanzee's, must involve mental operations with what psychologists call images. A visual image, a mental picture of, say, a banana, is always liable to be a picture of a particular banana in a particular setting. A word on the contrary is, as explained, more general and abstract, having eliminated just those accidental features that give individuality to any real banana. Mental images of words (pictures of the sound or of the muscular movements entailed in uttering it) form very convenient counters for thinking

with. Thinking with their aid necessarily possesses just that quality of abstractness and generality that animal thinking seems to lack. Men can think, as well as talk, about the class of objects called 'bananas'; the chimpanzee never gets further than 'that banana in that tube.' In this way the social instrument termed language has contributed to what is grandiloquently described as 'man's emancipation from bondage to the concrete.'" (G. Childe, What Happened in History, pp. 19-20.)

Early humans, after a long period of time, formed the general idea of, say, a plant or an animal. This arose out of the concrete observation of many particular

plants and animals. But when we arrive at the general concept "plant," we no longer see before us this or that flower or bush, but that which is common to all of them. We grasp the essence of a plant, its innermost being. Compared with this, the peculiar features of individual plants seem secondary and unstable. What is permanent and universal is contained in the general conception. We can never actually see a plant as such, as opposed to particular flowers and bushes. It is an abstraction of the mind. Yet it is a deeper and truer expression of what is essential to the plant's nature, when stripped of all secondary features.

However, the abstractions of early

humans were far from having a scientific character. They were tentative explorations, like the impressions of a child, guesses and hypotheses, sometimes incorrect, but always bold and imaginative. To early humans, the sun was a great being that sometimes warmed them, and sometimes burnt them. The earth was a sleeping giant. Fire was a fierce animal that bit them when they touched it.

Early humans experienced the phenomenon of thunder and lightning. This must have frightened them, as it still frightens animals and people today. But, unlike animals, humans looked for a general explanation of the phenomenon.

Given the lack of any scientific knowledge, the explanation was invariably a supernatural one—some god, hitting an anvil with his hammer. To our eyes, such explanations seem merely amusing, like the naïve explanations of children. Nevertheless, at this period they were extremely important hypotheses—an attempt to find a rational cause for the phenomenon, in which men distinguished between the immediate experience, and saw something entirely separate from it.

The most characteristic form of early religion is animism—the notion that everything, animate or inanimate has a spirit. We see the same kind of reaction

in a child when it smacks a table against which it has banged its head. In the same way, early humans, and certain tribes today, will ask the spirit of a tree to forgive them before cutting it down. Animism belongs to a period when humankind has not yet fully separated itself from the animal world and nature in general. The closeness of humans to the world of animals is attested to by the freshness and beauty of cave-art, where horses, deer and bison are depicted with a naturalness which can no longer be captured by the modern artist. It is the childhood of the human race, which has gone beyond recall. We can only imagine the psychology of these distant ancestors of ours. But by combining the

discoveries of archeology with anthropology, it is possible to reconstruct, at least in outline, the world from which we have emerged.

In his classic anthropological study of the origins of magic and religion, Sir James Frazer writes:

"A savage hardly conceives the distinction commonly drawn by more advanced peoples between the natural and the supernatural. To him the world is to a great extent worked by supernatural agents, that is, by personal beings acting on impulses and motives like his own, liable like him to be moved by appeals to their pity, their hope, and their fears.

In a world so conceived he sees no limit to this power of influencing the course of nature to his own advantage. Prayers, promises, or threats may secure him fine weather and an abundant crop from the gods; and if a god should happen, as he sometimes believes, to become incarnate in his own person, then he need appeal to no higher being; he, the savage, possesses in himself all the powers necessary to further his own well-being and that of his fellow-men." (Sir James Frazer, *The Golden Bough*, p. 10.)

The notion that the soul exists separate and apart from the body comes down from the most remote period of savagery. The basis of it is quite clear. When we

are asleep, the soul appears to leave the body and roam about in dreams. By extension, the similarity between death and sleep ("death's second self," as Shakespeare expressed it) suggested the idea that the soul could continue to exist after death. Early humans thus concluded that there is something inside them that is separate from their bodies. This is the soul, which commands the body, and can do all kinds of incredible things, even when the body is asleep. They also noticed how words of wisdom issued from the mouths of old people, and concluded that, whereas the body perishes, the soul lives on. To people used to the idea of migration, death was seen as the migration of the soul, which

needed food and implements for the journey.

At first these spirits had no fixed abode. They merely wandered about, usually making trouble, which obliged the living to go to extraordinary lengths to appease them. Here we have the origin of religious ceremonies. Eventually, the idea arose that the assistance of these spirits could be enlisted by means of prayer. At this stage, religion (magic), art and science were not differentiated. Lacking the means to gain real power over their environment, early humans attempted to obtain their ends by means of magical intercourse with nature, and thus subject it to their will.

The attitude of early humans to their spirit-gods and fetishes was quite practical. Prayers were intended to get results. A man would make an image with his own hands, and prostrate himself before it. But if the desired result was not forthcoming, he would curse it and beat it, in order to extract by violence what he failed to do by entreaty. In this strange world of dreams and ghosts, this world of religion, the primitive mind saw every happening as the work of unseen spirits. Every bush and stream was a living creature, friendly or hostile. Every chance event, every dream, pain or sensation, was caused by a spirit. Religious explanations filled the gap left by lack of

knowledge of the laws of nature. Even death was not seen as a natural occurrence, but a result of some offence caused to the gods.

For the great majority of the existence of the human race, the minds of men and women have been full of this kind of thing. And not only in what people like to regard as primitive societies. The same kind of superstitious beliefs continue to exist, in slightly different guises, today. Beneath the thin veneer of civilisation, lurk primitive irrational tendencies and ideas which have their roots in a remote past which has been half-forgotten, but is not yet overcome. Nor will they be finally rooted out of

human consciousness until men and women establish firm control over their conditions of existence.

Division of Labour

Frazer points out that the division between manual and mental labour in primitive society is invariably linked to the formation of a caste of priests, shamans or magicians:

"Social progress, as we know, consists mainly in a successive differentiation of functions, or, in simpler language, a division of labour. The work which in primitive society is done by all alike and by all equally ill, or nearly so, is gradually distributed among different

classes of workers and executed more and more perfectly; and so far as the products, material or immaterial, of his specialised labour are shared by all, the whole community benefits by the increasing specialisation. Now magicians or medicine-men appear to constitute the oldest artificial or professional class in the evolution of society. For sorcerers are found in every savage tribe known to us; and among the lowest savages, such as the Australian aborigines, they are the only professional class that exists." (Frazer, *The Golden Bough*, p. 104.)

The dualism which separates soul from body, mind from matter, thinking from

doing, received a powerful impulse from the development of the division of labour at a given stage of social evolution. The separation between mental and manual labour is a phenomenon which coincides with the division of society into classes. It marked a great advance in human development. For the first time, a minority of society was freed from the necessity to work to obtain the essentials of existence. The possession of that most precious commodity, leisure, meant that men could devote their lives to the study of the stars. As the German materialist philosopher Ludwig Feuerbach explains, real theoretical science begins with cosmology:

"The animal is sensible only of the beam which immediately affects life; while man perceives the ray, to him physically indifferent, of the remotest star. Man alone has purely intellectual, disinterested joys and passions; the eye of man alone keeps theoretic festivals. The eye which looks into the starry heavens, which gazes at that light, alike useless and harmless, having nothing in common with the earth and its necessities—this eye sees in that light its own nature, its own origin. The eye is heavenly in its nature. Hence man elevates himself above the earth only with the eye; hence theory begins with the contemplation of the heavens. The first philosophers were astronomers."

(Ludwig Feuerbach, The Essence of Christianity, p. 5.)

Although at this early stage this was still mixed up with religion, and the requirements and interests of a priest caste, it also signified the birth of human civilisation. This was already understood by Aristotle, who wrote:

"These theoretical arts, moreover, were evolved in places where men had plenty of free time: mathematics, for example, originated in Egypt, where a priestly caste enjoyed the necessary leisure."
(Metaphysics, p. 53.)

Knowledge is a source of power. In any society in which art, science and

government is the monopoly of a few, that minority will use and abuse its power in its own interests. The annual flooding of the Nile was a matter of life and death to the people of Egypt, whose crops depended on it. The ability of the priests in Egypt to predict, on the basis of astronomical observations, when the Nile would flood its banks must have greatly increased their prestige and power over society. The art of writing, a most powerful invention, was the jealously guarded secret of the priest-caste. As Prigogine and Stengers comment:

"Sumer discovered writing; the Sumerian priests speculated that the

future might be written in some hidden way in the events taking place around us in the present. They even systematised this belief, mixing magical and rational elements." (Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos*, p. 4.)

The further development of the division of labour gave rise to an unbridgeable gulf between the intellectual elite and the majority of humankind, condemned to labour with their hands. The intellectual, whether Babylonian priest or modern theoretical physicist, knows only one kind of labour, mental labour. Over the course of millennia, the superiority of the latter over "crude" manual labour becomes deeply ingrained and acquires

the force of a prejudice. Language, words and thoughts become endowed with almost mystical powers. Culture becomes the monopoly of a privileged elite, which jealously guards its secrets, and uses and abuses its position in its own interests.

In ancient times, the intellectual aristocracy made no attempt to conceal its contempt for physical labour. The following extract from an Egyptian text known as *The Satire on the Trades*, written about 2000 B.C. is supposed to consist of a father's exhortation to his son, whom he is sending to the Writing School to train as a scribe:

"I have seen how the belaboured man is belaboured—thou shouldst set thy heart in pursuit of writing. And I have observed how one may be rescued from his duties [sic!]
—behold, there is nothing which surpasses writing...

"I have seen the metalworker at his work at the mouth of his furnace. His fingers were somewhat like crocodiles; he stank more than fish-roe...

"The small building contractor carries mud...He is dirtier than vines or pigs from treading under his mud. His clothes are stiff with clay...

"The arrow-maker, he is very miserable as he goes out into the desert [to get flint points]. Greater is that which he gives to his donkey than its work thereafter [is

worth]...

"The laundry man launders on the [river] bank, a neighbour of the crocodile...

"Behold, there is no profession free of a boss—except for the scribe: he is the boss...

"Behold, there is no scribe who lacks food from the property of the House of the King—life, prosperity, health!...His father and his mother praise god, he being set upon the way of the living. Behold these things—I [have set them] before thee and thy children's children." (Quoted in M. Donaldson, *Children's Minds*, p. 84.)

The same attitude was prevalent among the Greeks:

"What are called the mechanical arts," says Xenophon, "carry a social stigma and are rightly dishonoured in our cities, for these arts damage the bodies of those who work in them or who act as overseers, by compelling them to a sedentary life and to an indoor life, and, in some cases, to spend the whole day by the fire. This physical degeneration results also in deterioration of the soul. Furthermore, the workers at these trades simply have not got the time to perform the offices of friendship or citizenship. Consequently they are looked upon as bad friends and bad patriots, and in some cities, especially the warlike ones, it is not legal for a citizen to ply a mechanical trade." (Oeconomicus, iv,

203, quoted in Farrington, op. cit., pp. 28-9.)

The radical divorce between mental and manual labour deepens the illusion that ideas, thoughts and words have an independent existence. This misconception lies at the heart of all religion and philosophical idealism.

It was not god who created man after his own image, but, on the contrary, men and women who created gods in their own image and likeness. Ludwig Feuerbach said that if birds had a religion, their God would have wings. "Religion is a dream, in which our own conceptions and emotions appear to us as separate

existences, beings out of ourselves. The religious mind does not distinguish between subjective and objective—it has no doubts; it has the faculty, not of discerning other things than itself, but of seeing its own conceptions out of itself as distinct beings." (Feuerbach, *The Essence of Christianity*, pp. 204-5.) This was already understood by men like Xenophanes of Colophon, who wrote "Homer and Hesiod have ascribed to the gods every deed that is shameful and dishonourable among men: stealing and adultery and deceiving each other... The Ethiopians make their gods black and snub-nosed, and the Thracians theirs grey-eyed and red-haired... If animals could paint and make things, like men,

horses and oxen too would fashion the gods in their own image." (Quoted in A. R. Burn, Pelican History of Greece, p. 132.)

The Creation myths which exist in almost all religions invariably take their images from real life, for example, the image of the potter who gives form to formless clay. In the opinion of Gordon Childe, the story of the Creation in the first book of Genesis reflects the fact that, in Mesopotamia the land was indeed separated from the waters "in the Beginning," but not by divine intervention:

"The land on which the great cities of

Babylonia were to rise had literally to be created; the prehistoric forerunner of the biblical Erech was built on a sort of platform of reeds, laid crisscross upon the alluvial mud. The Hebrew book of Genesis has familiarised us with much older traditions of the pristine condition of Sumer—a ‘chaos’ in which the boundaries between water and dry land were still fluid. An essential incident in ‘The Creation’ is the separation of these elements. Yet it was no god, but the proto-Sumerian themselves who created the land; they dug channels to water the fields and drain the marsh; they built dykes and mounded platforms to protect men and cattle from the waters and raise them above the flood; they made the first

clearings in the reed brakes and explored the channels between them. The tenacity with which the memory of this struggle persisted in tradition is some measure of the exertion imposed upon the ancient Sumerians. Their reward was an assured supply of nourishing dates, a bounteous harvest from the fields they had drained, and permanent pastures for flocks and herds." (G. Childe, *Man Makes Himself*, pp. 107-8.)

Man's earliest attempts to explain the world and his place in it were mixed up with mythology. The Babylonians believed that the god Marduk created Order out of Chaos, separating the land

from the water, heaven from earth. The biblical Creation myth was taken from the Babylonians by the Jews, and later passed into the culture of Christianity. The true history of scientific thought commences when men and women learn to dispense with mythology, and attempt to obtain a rational understanding of nature, without the intervention of the gods. From that moment, the real struggle for the emancipation of humanity from material and spiritual bondage begins.

A Revolution in Thought

The advent of philosophy represents a genuine revolution in human thought.

Like so much of modern civilisation, we owe it to the ancient Greeks. Although important advances were also made by the Indians and Chinese, and later the Arabs, it was the Greeks who developed philosophy and science to its highest point prior to the Renaissance. The history of Greek thought in the four hundred year period, from the middle of the 7th century B.C., constitutes one of the most imposing pages in the annals of human history.

Here we have a long line of heroes who pioneered the development of thought. The Greeks discovered that the world was round, long before Columbus. They explained that humans had evolved from

fishes long before Darwin. They made extraordinary discoveries in mathematics, especially geometry, which were not greatly improved upon for one and a half millennia. They invented mechanics and even invented the steam engine.

What was startlingly new about this way of looking at the world was that it was not religious. In complete contrast to the Egyptians and Babylonians, from whom they had learnt a lot, the Greek thinkers did not resort to gods and goddesses to explain natural phenomena. For the first time, men and women sought to explain the workings of nature purely in terms of nature. This was one of the greatest

turning-points in the entire history of human thought. True science starts here.

The Birth of Philosophy

Western philosophy was born under the clear blue skies of the early Aegean. The 8th and 7th centuries B.C. was a period of rapid economic expansion in the eastern Mediterranean. These were stirring times. The Greeks of the Ionian islands, which now lie off the coast of Turkey, conducted a thriving trade with Egypt, Babylon and Lydia. The Lydian invention of money was introduced into Europe via Aegina at about 625 B.C., greatly stimulating trade, bringing in its wake great riches for some and

indebtedness and slavery for others.

The earliest Greek philosophy represents the true starting point of philosophy. It is an attempt to struggle free from the age-old bounds of superstition and myth, to dispense with gods and goddesses, so that, for the first time, human beings could stand face to face with nature and with real men and women.

The economic revolution gave rise to new social contradictions. The breakdown of the old patriarchal society provoked a clash between rich and poor. The old aristocracy was faced with the discontent of the masses and the

opposition of the "tyrants," frequently dissident nobles themselves, who were always willing to put themselves at the head of popular risings. A period of instability opened up, in which men and women began to question the old beliefs.

The situation in Athens at this time is described in the following passage:

"In the bad years they (the peasants) had to borrow from rich neighbours; but with the coming of money, this meant that, instead of borrowing a sack of corn in the good old neighbourly way, one had to borrow the price of enough corn to tide one over, before the harvest, when it was cheap; or alternatively, to pay heavy

interest, of the kind that raised such indignation at Megara. By 600, while rich men exported to good markets in Aegina or Corinth, poor men were going hungry. Many, too, were losing their land, pledged as security for debts, and even their liberty; for the debtor's last recourse against the insolvent debtor was to seize him and his family as slaves...The law was harsh; it was rich man's law." (A. R. Burn, *The Pelican History of Greece*, p. 119.)

These laws were put into a code by one Drakon, from which the phrase "Draconian laws" has become proverbial.

The turbulent 6th century B.C. was a period of decline of the Greek Ionian republics of Asia Minor, characterised by social crisis and ferocious class struggle between rich and poor, masters and slaves. "At Miletus, in Asia Minor," writes Rostovtsev, "the people were at first victorious and murdered the wives and children of the aristocrats; then the aristocrats prevailed and burned their opponents alive, lighting up the open spaces of the city with live torches." (Quoted in Bertrand Russell, History of Western Philosophy, p. 44.)

These conditions were typical of most other Greek cities of Asia Minor, at the time. The heroes of this age had nothing

in common with the later idea of the philosopher, isolated from the rest of humanity in his ivory tower. These "wise men" were not only thinkers, but doers, not only theoreticians, but practical men of the world. Of the first of them, Thales of Miletus (c. 640-546 B.C.), we know next to nothing, but it is expressly stated that it was only late in life that he took to philosophy, and that he was also involved in commerce, engineering, geometry and astronomy (he is said to have predicted an eclipse, which must have been the one in 585 B.C.).

What is indisputable is that all the early Greek philosophers were materialists. Turning their backs on mythology, they

sought to find a general principle for the workings of nature from an observation of nature itself. The later Greeks refer to them as hylozoists, which can be translated as "those who think that matter is alive." This conception of matter as self-moving is strikingly modern, and far superior to the mechanical physics of the 18th century. Given the absence of modern scientific instruments, their theories frequently had the character of inspired guesswork. But, taking into account the lack of resources, the amazing thing is how close they came to a real understanding of the workings of nature. Thus the philosopher Anaximander (c. 610-545 B.C.) worked out that man and all other animals had

developed from a fish, which abandoned water for the land.

It is misleading to suppose that these philosophers were religious just because they used the word "god" (theos) in relation to primary substance. J. Burnet states that it meant no more than the old Homeric epithets like "ageless," "deathless," etc. Even in Homer, the word is used in several different senses. From Hesiod's Theogony it is clear that many of the "gods" were never worshipped, but were merely convenient personifications of natural phenomena or even human passions. Primitive religions looked on the heavens as divine and set apart from the earth. The

Ionian philosophers radically broke with this standpoint. While basing themselves on the many discoveries of Babylonian and Egyptian cosmology, they rejected the mythical element, which confused astronomy with astrology.

The general tendency of Greek philosophy before Socrates was to search for the underlying principles of nature:

"Nature it was—that which is most immediately present to us, that which lies nearest the eye, that which is palpablest—that first attracted the spirit of inquiry. Under its changeful forms, its multiplex phenomena, there must lie, it

was thought, a first and permanent fundamental principle. What is this principle? What precisely, what natural element is the basic element?"

(Schwegler, History of Philosophy, p. 6.)

They gave different explanations for this. For example, Thales claimed that the basis of all things is water. This was a great advance for human thought. True, the Babylonians had long before put forward the idea that all things came from water. In their Creation myth, which was the model for the Hebrew story of the Creation in the first book of Genesis. "All lands were sea," says the legend, until Marduk, the Babylonian

creator, separated the land from the sea. The difference here is that there is no Marduk, no divine creator standing outside nature. Instead, for the first time, nature is explained in purely materialist terms, that is, in terms of nature itself.

Nor is the idea of nature as reducible to water as far-fetched as it might appear. Apart from the fact that the great majority of the earth's surface is made up of water, something the Ionian Greeks above all were aware of, water is essential for all forms of life. The bulk of our body consists of water, and we would quickly die if deprived of it. Moreover, water changes its forms, passing from a liquid to a solid, to a

vapour. On this Burnet comments:

"Nor is it hard to see how the meteorological considerations may have led Thales to adopt the views he did. Of all the things we know, water seems to take the most various shapes. It is familiar to us in a solid, a liquid, and a vaporous form, and so, Thales may well have thought he saw the world-process from water and back to water again going on before his eyes. The phenomenon of evaporation naturally suggests that the fire of the heavenly bodies is kept up by the moisture they draw from the sea. Even at the present day, people speak of the 'sun drawing up water.' Water comes down again in rain;

and lastly, so the early cosmologists thought, it turns to earth. This may have seemed natural enough to men who were familiar with the rivers of Egypt which had formed the Delta, and the torrents of Asia Minor which bring down large alluvial deposits." (J. Burnet, Early Greek Philosophers, p. 49.)

Anaximander

Thales was followed by others philosophers who advanced different theories as to the basic structure of matter. Anaximander is said to have come from Samos, where the famous Pythagoras also lived. He is said to have written about nature, the fixed stars, the

earth's sphere and other matters. He produced something like a map, showing the boundary of land and sea, and was responsible for a number of mathematical inventions, including a sundial and an astronomical chart.

Like Thales, Anaximander considered what the nature of reality was. Like him, he approached this question from a strictly materialist point of view, without recourse to the gods or any supernatural elements. But, unlike his contemporary, Thales, he did not seek to find the answer in a particular form of matter, such as water. According to Diogenes, "He adduced the Infinite (the indetermined) as the principle and

element; he neither determined it as water, air or any such thing." (Quoted in Hegel's History of Philosophy, Vol. one, p. 185.) And again, "It is the principle of all becoming and passing away; at long intervals infinite worlds or gods rise out of it, and again they pass away into the same." (Ibid.)

This put the study of the universe on a scientific footing for the first time, and enabled the early Greek philosophers to make outstanding discoveries, far in advance of their time. They first discovered that the world is round and does not rest on anything, that the earth was not the centre of the universe, but revolves with the other planets round the

centre. According to another contemporary, Hippolitos, Anaximander said that the earth swings free, held in place by nothing, because it is equidistant from everything, and is round in shape and hollow, like a pillar, so that we are on one side of the earth, and others on the other. They also discovered the true theory of lunar and solar eclipses.

With all their gaps and deficiencies, these ideas represent a startlingly bold and original conception of nature and the universe, certainly far nearer to the truth than the blinkered mysticism of the Middle Ages, when human thought was again shackled by religious dogma.

Moreover, these important advances were not merely the result of guesswork, but the result of careful thought, investigation and experiment. 2,000 years before Darwin, Anaximander anticipated the theory of evolution, with his amazing discoveries in marine biology. The historian A. R. Burn believes that this was no accident, but the result of scientific investigation: "It looks as though he had made observations on embryos and also on fossils, as one of his successors certainly did; but we are not positively told." (A. R. Burn, *The Pelican History of Greece*, p. 130.)

Anaximander effected a great revolution

in human thought. Instead of limiting himself to this or that concrete form of matter, he arrived at the concept of matter in general, matter as a philosophical concept. This universal substance is eternal and infinite, constantly changing and evolving. All the myriad forms of being we perceive through our senses are different expressions of the same basic substance. This idea was so novel that for many it proved incomprehensible. Plutarch complained that Anaximander did not specify which one of the elements his Infinite was—water, earth, air or fire. But precisely in this lay the epoch-making character of the theory.

Anaximenes

The last of the great trio of Ionian materialists was Anaximenes (c. 585-528 B.C.). He is said to have been born when Thales "flourished," and to have "flourished" when Thales died. He was younger than Anaximander. Unlike Anaximander, and following Thales, he took a single element—"air"—as the absolute substance, from which everything comes forth and to which everything is ultimately reduced. In fact, Anaximenes' use of the word "air" (aer) differs substantially from the modern usage. It includes vapour, mist and even darkness. Many translators prefer the word "mist."

At first sight, this idea represents a step back in comparison to the position of matter in general arrived at by Anaximander. In fact, his world-view was a step forward.

Anaximenes attempted to show how "air," the universal substance, becomes transformed through a process of what he called rarification and condensation. When it is rarefied, it becomes fire, when condensed, wind. By further condensation, we get clouds, water, earth and stones. But although in details his view of the universe compares unfavourably with that of Anaximander (he thought the world was shaped like a table, for instance), nevertheless, his

philosophy represented an advance, inasmuch as he tried to move beyond a general statement of the nature of matter. He attempted to give it a more precise determination, not only qualitatively, but quantitatively, through the process of rarification and condensation. In the words of professor Farrington:

"Observe, in following this succession of thinkers, how their logic, their stock of ideas, their power of abstraction, increase as they grapple with their problem. It was a great advance in human thinking when Thales reduced the manifold appearances of things to one First Principle. Another great step was taken when Anaximander chose, as his

First Principle, not a visible form of things like water, but a concept like the Indeterminate. But Anaximenes was still not content. When Anaximander sought to explain how the different things emerged from the Indeterminate, he gave a reply that was a mere metaphor. He said it was a process of 'separating out.' Anaximenes felt that something more was needed, and came forward with the complementary ideas of Rarification and Condensation, which offered an explanation of how quantitative changes could produce qualitative ones." (B. Farrington, op. cit., p. 39.)

Given the existing level of technique, it was impossible for Anaximenes to

arrive at a more precise characterisation of the phenomena under consideration. It is easy to point to the deficiencies and even absurdities of his views. But this would miss the point. The early Greek philosophers cannot be blamed for failing to provide their world picture with a detailed content, which was only possible on the basis of over 2,000 years of subsequent economic, technological and scientific advance. These great pioneers of human thought rendered humanity the unique service of breaking away from the age-old habits of religious superstition, and thereby laid the foundation without which all scientific and cultural advance would have been unthinkable.

Moreover, the general view of the universe and nature elaborated by these great revolutionary thinkers was in many respects close to the truth. Their problem was that, given the level of development of production and technology, they did not have the means of testing their hypotheses, and putting them on a solid footing. They anticipated many things which could only be fully worked out by modern science, resting on a far higher development of science and technique. Thus, for Anaximenes, "air" is only shorthand for matter in its simplest, most basic form. As Erwin Schrödinger, one of the founders of modern physics shrewdly remarked: "Had he said dissociated hydrogen gas,"

(which he could hardly be expected to say), "he would not be so far from our present view." (Quoted in A. R. Burn, *op. cit.*, p. 131.)

The earlier Ionian philosophers of nature had probably gone as far as they could to explain the workings of nature by means of speculative reason. These were truly great generalisations, which pointed in the right direction. But, in order to carry the process further, it was necessary to examine things in greater detail, to proceed to analyse nature piece by piece. This was later begun by Aristotle and the Alexandrine Greek thinkers. But an important part of this task was to consider nature from a quantitative point

of view. Here the Pythagorean philosophers undoubtedly played a major role.

Already Anaximenes had pointed in this direction, in attempting to pose the question of the relation between changes of quantity and quality in nature (rarification and condensation). But this method had by now reached its limits and exhausted itself. As J. D. Bernal puts it: "The triumph of the Ionian school was that it had set up a picture of how the universe had come into being and how it worked without the intervention of gods or design. Its basic weakness was its vagueness and qualitative character. By itself it could lead

nowhere; nothing could be done with it. What was needed was the introduction of number and quantity into philosophy." (J. D. Bernal, Science in History, p. 122.)

From Materialism to Idealism

The period of the ascent of ancient Greek philosophy was characterised by a profound crisis of society, marked by a general questioning of the old beliefs, including the established religion. The crisis of religious belief gave rise to atheist tendencies, and the birth of a genuinely scientific outlook, based on materialism. However, as always in society, the process took place in a

contradictory way. Alongside the rationalist and scientific tendencies, we also see the opposite—a growing trend towards mysticism and irrationality. A very similar phenomenon occurred at the time of the crisis of Roman society, in the last period of the republic, with the rapid spread of oriental religions, of which Christianity was originally only one among many.

To the mass of peasants and slaves, living in a time of social crisis, the gods of Olympus seemed remote. This was a religion for the upper classes. There was no prospect of a future reward for present suffering in the after-life. The Greek underworld was a cheerless place

inhabited by lost souls. The newer cults, with their mimetic dancing and choral singing (the real origin of Greek tragedy), their mysteries (from the verb "myo," meaning to keep your mouth shut), and the promise of life after death, was far more attractive to the masses. Particularly popular was the cult of Dionysius, the god of wine (known to the Romans as Bacchus), which involved drunken orgies. This was much more appealing than the old gods of Olympia.

As in the period of decline of the Roman empire, and in the present period of capitalist decline, there was a spread of all kinds of mystery cults, mixed with new exotic rites imported from Thrace

and Asia Minor and possibly Egypt. Of particular importance was the cult of Orpheus, a refinement of the cult of Dionysius, with many points in common with the Pythagorean movement. Like the Pythagoreans, the followers of the cult of Orpheus believed in the transmigration of souls. They had rites of purification, including abstaining from meat, except for sacramental purposes. Their view of man was based on dualism—the idea of the cleavage of body and soul. For them, man was partly of heaven, partly of earth.

So close are these ideas to the Pythagorean doctrines that some authors, such as Bury, maintain that the

Pythagoreans were really a branch of the Orphean movement. This is an exaggeration. Despite its mystical elements, the Pythagorean school made an important contribution to the development of human thought, especially mathematics. It cannot be dismissed as a religious sect. Nevertheless, it is impossible to resist the conclusion that the idealist conceptions of Pythagoreanism are not just an echo of a religious world outlook, but stem directly from it. Bertrand Russell traces the development of idealism back to the mysticism of the Orphean religion:

"This mystical element entered into

Greek philosophy with Pythagoras, who was a reformer of orpheanism as Orpheus was a reformer of the religion of Dionysius. From Pythagoras Orphic elements entered into the philosophy of Plato, and from Plato into most later philosophy that was in any degree religious." (Russell, op. cit., p. 39.)

The division between mental and manual labour reaches an extreme expression with the growth of slavery. This phenomenon was directly related to the spread of Orphism. Slavery is an extreme form of alienation. Under capitalism, the "free" worker alienates himself from his labour-power, which presents itself to him as a separate and

hostile force—capital. Under slavery, however, the slave loses his very existence as a human being. He is nothing. Not a person, but a "tool with a voice." The product of his labour, his body, his mind, his soul are the property of another, who disposes of them without regard to his wishes. The unfulfilled desires of the slave, his extreme alienation from the world and himself, gives rise to a feeling of rejection towards the world and all its works. The material world is evil. Life is a vale of tears. Happiness is not to be found there, only in death, which gives release from toil. The soul, freed from its prison in the body, can become free.

In all periods of social decline, men and women have two options: either to confront reality, and fight to change it, or to accept that there is no way out, and resign themselves to their fate. These two contrasting outlooks are inevitably reflected in two antagonistic philosophies—materialism and idealism. If we desire to change the world, it is necessary to understand it. We must look reality in the face. The cheerful optimism of the early Greek materialists was typical of this outlook. They wanted to know. Later, all that changed. The break-up of the old order, the rise of slavery and a general sense of insecurity led to a certain introversion and pessimism. In the absence of a clear

alternative, the tendency to look away from reality, to seek individual salvation in mysticism, gradually gained ground. The lower orders looked to mystery cults, like those of Demeter, giver of corn, Dionysius, giver of wine, and later the cult of Orpheus. But the upper classes were not immune to the problems of the period. These were troubled times. Prosperous cities could be turned to ashes overnight, and their citizens killed or sold into slavery.

The city of Sybaris, Croton's powerful commercial rival, was renowned for its wealth and luxury. So wealthy were the upper class that all kind of tall stories were told about the "sybarite" life style.

A typical example was the young Sybarite who, upon rising, complained of a crumpled rose-leaf in his bed. It is said that they piped their wine to the quay. Allowing for an element of exaggeration, it is clear that this was a most prosperous city, where the rich lived a life of great luxury. However, the growth of inequality gave rise to a ferocious class struggle.

This was a period in which the division of labour was enormously intensified, accompanied by the rapid growth of slavery, and an ever-increasing gulf between rich and poor. The industrial and residential quarters were completely segregated. But high walls and guards

did not save the rich citizens of Sybaris. As in other city states, a revolution erupted, in which the "tyrant," Telys, seized power with the support of the masses. This gave Croton the excuse to declare war on its rival, at a moment when it was weakened by internal divisions. After a seventy day campaign, the city fell into their hands. A. R. Burn comments: "They utterly destroyed it, turning the local river across its site, while survivors scattered, largely to the west coast. The particular savagery of this war is more easily understood when it is seen as a class war." (A. R. Burn, op. cit., p. 140.)

It is in this specific context that we must

see the rise of the Pythagorean school of philosophy. As in the period of decline of the Roman Empire, a section of the ruling class was filled with a feeling of anxiety, fear and perplexity. The old gods offered no solace or hope of delivery, either to rich or poor. Even the good things in life lost some of their appeal to men and women who felt they were sitting on the edge of an abyss. Under such conditions of general insecurity, when even the strongest and most prosperous states could be overthrown in a short time, the doctrines of Pythagoras struck a chord with a section of the ruling class, despite their ascetic character, or even because of it. The esoteric and intellectual nature of

this movement gave it no appeal to the masses, where the Orphic cult had gained a huge following.

Pythagoras and His School

It is safer to speak of the school rather than of its founder, since it is difficult to disentangle the philosophy of Pythagoras from the myths and obscurantism of his followers. No written fragments of his have survived, and it is doubtful if they ever existed. Even the existence of Pythagoras has been questioned. However, the influence of his school on Greek thought was profound.

Pythagoras is said to have been a native of the island of Samos, a thriving

commercial power, like Miletus. Its local dictator ("tyrant"), Polycrates, had overthrown the landed aristocracy and was ruling with the support of the merchant class. Of him, the historian Herodotos reports that he robbed all men indiscriminately, for he said that his friends were more grateful if he gave them their property back than they would have been if he had never taken it! In his youth, Pythagoras apparently worked as a "philo-sophos" (lover of wisdom) under the patronage of Polycrates. He travelled to Phoenicia and Egypt, where he is said to have been initiated into an Egyptian priest caste. In 530 B.C., he fled to Croton in southern Italy to escape from civil strife and the threat posed by

the Persians to Ionia.

The luxuriant overgrowth of myth and fable makes it almost impossible to say anything certain about the man. His school certainly was a remarkable mixture of mathematical and scientific investigation and a religious-monastic sect. The community was run on monastic lines, with strict rules which included, for instance: not to eat beans; not to pick up what was fallen; not to stir the fire with iron; not to step over a crowbar, etc. The whole idea was to escape from the world, to seek salvation in a life of peaceful contemplation based on mathematics, which was invested with supposedly mystical qualities.

Probably reflecting oriental influences, the Pythagoreans also preached the transmigration of souls.

In contrast to the cheerful worldliness of the Ionian materialists, here we have all the elements of the later idealist world outlook later developed by Plato, and taken over by Christianity, which bedevilled the growth of the spirit of scientific inquiry for many centuries. The moving spirit behind this ideology is aptly expressed by J. Burnet in the following lines:

"We are strangers in this world, and the body is the tomb of the soul, and yet we must not seek to escape by self-murder:

for we are the chattels of God who is our herdsman, and without His command we have no right to make our escape. In this life, there are three kinds of men, just as there are three sorts of people who come to the Olympic Games. The lowest class is made up of those who come to buy and sell, the next above them are those who come to compete. Best of all, however, are those who simply come to look on. The greatest purification of all is, therefore, disinterested science, and it is the man who devotes himself to that, the true philosopher, who has most effectively released himself from the 'wheel of birth.'" (Quoted in Russell, op. cit., p. 52.)

This philosophy, with its strong elitist and monastic overtones, proved popular with the wealthy classes of Croton, although how many really gave up eating beans, or anything else, may be open to doubt! The common thread in all this is the radical separation of the soul from the body. This idea, with its roots in a prehistoric conception of man's place in nature, has been passed down in different forms throughout history. It even resurfaces in one of the Hippocratic treatises:

"When the body is awake, the soul is not her own mistress but serves the body, her attention divided between the various bodily senses—sight, hearing,

touch, waking and all bodily actions—which deprive the mind of its independence. But, when the body is at rest, the soul wakes and stirs and keeps her own house, and carries out herself all the activities of the body. In sleep the body does not feel, but the soul awake knows everything; she sees what is to be seen, hears what has to be heard, walks, touches, grieves, remembers—in a word, all the functions of body and soul alike are performed in sleep by the soul. And therefore anyone who knows how to interpret these matters possesses a great part of wisdom."

In contrast to the Ionian materialist philosophers, who deliberately turned

their backs on religion and mythology, the Pythagoreans took over the idea of the Orphic mystery cult that the soul could free itself from the body by means of an "ecstasy" (the word ekstasis means "stepping out"). Only when the soul left the prison of the body was it deemed to express its true nature. Death was life and life was death. Thus, from its inception, philosophical idealism, in common with its Siamese twin, religion, represented an inversion of the real relation between thought and being, man and nature, people and things, which has persisted down to the present time, in one form or another, with the most pernicious results.

The Pythagorean Doctrine

In spite of its mystical character, the Pythagorean doctrine marked a step forward in the development of philosophy. There is nothing strange about this. In the evolution of human thought, there are many instances in which the pursuit of irrational and unscientific goals nevertheless have furthered the cause of science. For centuries, the alchemists exerted themselves fruitlessly in an attempt to discover the "philosopher's stone." This ended in failure. But in the process, they made extremely important discoveries in the field of experiment which provided the basis upon which modern science,

especially chemistry, later developed.

The basic tendency of Ionian philosophy was an attempt to generalise from the experience of the real world. Pythagoras and his followers attempted to arrive at an understanding of the nature of things by a different route. Schwegler puts it thus:

"We have the same abstraction, but on a higher stage, when the sensuous concretion of matter in general is looked away from; when attention is turned no longer to the qualitative aspect of matter, as water, air, etc., but to its quantitative measure and relations; when reflection is directed, not to the material, but to the

form and order of things as they exist in space." (Schwegler, History of Philosophy, p. 11.)

The progress of human thought in general is closely linked to the capacity to make abstractions from reality, to be able to draw general conclusions from a host of particulars. Since reality is many-sided, it is possible to interpret it in many different ways, reflecting this or that element of the truth. This we see many times in the history of philosophy, where great thinkers laid hold of one aspect of reality, and held it up as an absolute and final truth, only to be swept away by the next generation of thinkers, who in turn repeat the process. Yet the rise and fall

of great philosophical schools and scientific theories represents the development and enrichment of human thought by a process of endless successive approximations.

The Pythagoreans approached the world from the standpoint of number and quantity relations. For Pythagoras, "all things are numbers." This idea was linked to the search for the underlying harmony of the universe. They believed that number was the element out of which all things developed. Despite the mystical element, they made important discoveries which greatly stimulated the development of mathematics, especially geometry. They invented the terms odd

and even numbers, odd numbers being male and even ones female. Since no women were allowed in the community, they naturally declared odd numbers to be divine and even ones earthly!

Likewise, our terms squares and cubes of numbers come from the Pythagoreans, who also discovered harmonic progression in the musical scale, linking the length of a string and the pitch of its vibrating note.

These important discoveries were not put to any practical use by the Pythagoreans, who were interested in geometry purely from an abstract mystical point of view. Yet they had a determining influence on subsequent

thought. The mystique of mathematics as an esoteric subject, inaccessible to ordinary mortals, has persisted down to the present day. It was transmitted through the idealist philosophy of Plato, who placed over the entrance of his school the inscription: "Let no man destitute of geometry enter my doors."

"The cosmology of the Pythagoreans," writes professor Farrington, "is very curious and very important. They did not, like the Ionians, try to describe the universe in terms of the behaviour of certain material elements and physical processes. They described it exclusively in terms of number. Aristotle said long afterwards that they took number to be

the matter as well as the form of the universe. Numbers constituted the actual stuff of which their world was made. They called a point One, a line Two, a surface Three, a solid Four, according to the minimum number of points necessary to define each of these dimensions." (Farrington, op. cit., p. 47.) They attached magical significance to particular numbers—three, four, seven. Of particular significance was the number ten which is the sum of 1, 2, 3, and 4. These superstitions still persist in the Holy Trinity, the four horsemen of the Apocalypse, the seven deadly sins, and the like. "It is also apparent," adds Bernal, "in modern mathematical physics whenever its adepts try to make god the

supreme mathematician." (Bernal, op. cit., p. 124.)

The history of science is characterised by the most fierce partisanship, at times bordering on fanaticism, in defence of particular schools of thought, which put themselves forward as the protagonists of an absolute truth, and who do in fact embody the maximum point reached by human knowledge at a given point in time. Only the further development of science itself reveals the limitations and inner contradictions of a given theory, which is then negated by its opposite, which is itself negated, and so on ad infinitum. This process is precisely the dialectic of the history of science, which

for centuries proceeded in tandem with the history of philosophy, and initially was virtually indistinguishable from it.

"All Things Are Numbers"

The development of the quantitative side of investigating nature was obviously of crucial importance. Without it, science would have remained on the level of mere generalities incapable of further development. However, when such a breakthrough takes place, there is inevitably a tendency to make exaggerated claims on its behalf. This is particularly true in this case, where science is still entangled with religion.

The Pythagoreans saw number—

quantitative relations—as the essence of all things. "All things are numbers." Indeed, it is possible to explain many natural phenomena in mathematical terms. Nevertheless, even the most advanced mathematical models are only approximations of the real world. The inadequacy of the purely quantitative approach, however, was evident long ago. G. W. F. Hegel, who, as a convinced idealist and a formidable mathematician, might have been expected to be enthusiastic about the Pythagorean school, however, this was far from the case. Hegel poured scorn on the idea that the world could be reduced to quantitative relations.

From Pythagoras onwards, the most extravagant claims have been made on behalf of mathematics, which has been portrayed as the queen of the sciences, the magic key opening all doors of the universe. Breaking free from all contact with crude material reality, mathematics appeared to soar into the heavens, where it acquired a god-like existence, obeying no rule but its own. Thus, the great mathematician Henri Poincaré, in the early years of this century, could claim that the laws of science did not relate to the real world at all, but represented arbitrary conventions destined to promote a more convenient and "useful" description of the corresponding phenomena. Many physicists now openly

state that the validity of their mathematical models does not depend upon empirical verification, but on the aesthetic qualities of their equations.

Thus, the theories of mathematics have been, on the one side, the source of tremendous scientific advance, and, on the other, the origin of numerous errors and misconceptions which have had, and are still having profoundly negative consequences. The central error is to attempt to reduce the complex, dynamic and contradictory workings of nature to static, orderly quantitative formulae. Starting with the Pythagoreans, nature is presented in a formalistic manner, as a single-dimensional point, which

becomes a line, which becomes a plane, a cube, a sphere, and so on. At first sight, the world of pure mathematics is one of absolute thought, unsullied by contact with material things. But this is far from the truth, as Engels points out. We use the decimal system, not because of logical deduction or "free will," but because we have ten fingers. The word "digital" comes from the Latin word for fingers. And to this day, a schoolboy will secretly count his material fingers beneath a material desk, before arriving at the answer to an abstract mathematical problem. In so doing, the child is unconsciously retracing the way in which early humans learned to count.

The material origins of the abstractions of mathematics were no secret to Aristotle: "The mathematician," he wrote, "investigates abstractions. He eliminates all sensible qualities like weight, density, temperature, etc., leaving only the quantitative and continuous (in one, two or three dimensions) and its essential attributes." (Metaphysics, p. 120.) Elsewhere he says: "Mathematical objects cannot exist apart from sensible (i.e., material) things." (Ibid, p. 251.) And, "We have no experience of anything which consists of lines or planes or points, as we should have if these things were material substances, lines, etc., may be prior in definition to body, but they are not on

that account prior in substance." (Ibid, p. 253.)

The development of mathematics is the result of very material human needs. Early man at first had only ten number sounds, precisely because he counted, like a small child, on his fingers. The exception were the Mayas of Central America who had a numerical system based on twenty instead of ten, probably because they counted their toes as well as their fingers. Early man, living in a simple hunter-gatherer society, without money or private property, had no need of large numbers. To convey a number larger than ten, he merely combined some of the ten sounds connected with

his fingers. Thus, one more than ten is expressed by "one-ten," (undecim, in Latin, or ein-lifon—"one over"—in early Teutonic, which becomes eleven in modern English). All the other numbers are only combinations of the original ten sounds, with the exception of five additions—hundred, thousand, million, billion and trillion.

The real origin of numbers was already understood by the great English materialist philosopher of the 17th century Thomas Hobbes: "And it seems, there was a time when those names of number were not in use; and men were fayne to apply their fingers of one or both hands, to those things they desired to

keep account of; and that thence it proceeded, that now our numerall words are but ten, in any Nation, and in some but five, and then they begin again." (Hobbes, Leviathan, p. 14.)

Alfred Hooper explains: "Just because primitive man invented the same number of number-sounds as he had fingers, our number-scale today is a decimal one, that is, a scale based on ten, and consisting of endless repetitions of the first ten basic number-sounds...Had men been given twelve fingers instead of ten, we should doubtless have a duo-decimal number-scale today, one based on twelve, consisting of endless repetitions of twelve basic number-sounds." (A.

Hooper, Makers of Mathematics, p. 4-5.) In fact, a duodecimal system has certain advantages in comparison to the decimal one. Whereas ten can only be exactly divided by two and five, twelve can be divided exactly by two, three, four and six.

The Roman numerals are pictorial representations of fingers. Probably the symbol for five represented the gap between thumb and fingers. The word "calculus" (from which we derive "calculate") means "pebble" in Latin, connected with the method of counting stone beads on an abacus. These, and countless other examples serve to illustrate how mathematics did not arise

from the free operation of the human mind, but is the product of a lengthy process of social evolution, trial and error, observation and experiment, which gradually becomes separated out as a body of knowledge of an apparently abstract character.

Similarly, our present systems of weights and measures have been derived from material objects. The origin of the English unit of measurement, the foot, is self-evident, as is the Spanish word for an inch, "pulgada," which means a thumb. The origin of the most basic mathematical symbols $+$ and $-$ has nothing to do with mathematics. They were the signs used in the Middle Ages

by the merchants to calculate excess or deficiency of quantities of goods in warehouses.

The need to build dwellings to protect themselves from the elements forced early man to find the best and most practical way of cutting wood so that their ends fitted closely together. This meant the discovery of the right angle and the carpenters' square. The need to build a house on level ground led to the invention of the kind of levelling instrument depicted in Egyptian and Roman tombs, consisting of three pieces of wood joined together in an isosceles triangle, with a cord fastened at the apex. Such simple practical tools were

used in the construction of the pyramids. The Egyptian priests accumulated a huge body of mathematical knowledge derived ultimately from such practical activity.

The very word "geometry" betrays its practical origins. It means simply "earth-measurement." The virtue of the Greeks was to give a finished theoretical expression to these discoveries.

However, in presenting their theorems as the pure product of logical deduction, they were misleading themselves and future generations. Ultimately, mathematics derives from material reality, and, indeed, could have no application if this were not the case.

Even the famous theorem of Pythagoras, known to every school pupil, that a square drawn on the longest side of a right triangle is equal to the sum of the squares drawn on the other two sides, had been already worked out in practice by the Egyptians.

The Pythagoreans, breaking with the Ionian materialist tradition which attempted to generalise on the basis of experience of the real world, asserted that the higher truths of mathematics could not be derived from the world of sensuous experience, but only from the workings of pure reason, by deduction. Beginning with certain first principles, which have to be taken as true, the

philosopher argues them through a series of logical stages until he arrives at a conclusion, using only facts that are agreed first principles, or are derived from such. This was known as a priori reasoning, from the Latin phrase denoting "from what comes first."

Using deduction and a priori reasoning, the Pythagoreans attempted to establish a model of the universe based on perfect forms and governed by divine harmony. The problem is that the forms of the real world are anything but perfect. For instance, they thought that the heavenly bodies were perfect spheres moving in perfect circles. This was a revolutionary advance for its time, but neither of these

assertions is really true. The attempt to impose a perfect harmony on the universe, to free it from contradiction, soon broke down even in mathematical terms. Internal contradictions began to surface which led to a crisis of the Pythagorean school.

About the middle of the 5th century, Hippius of Metapontum discovered that the quantitative relations between the side and the diagonal of simple figures like the square and the regular pentagon are incommensurable, that is, they cannot be expressed as a ratio of whole numbers, no matter how great. The square root of two cannot be expressed by any number. It is, in fact, what

mathematicians call an "irrational" number. This discovery threw the whole theory into confusion. Hitherto, the Pythagoreans had taught that the world was constructed out of points with magnitude. While it might not be possible to say how many points there were on a given line, still they were assumed to be finite in number. Now if the diagonal and the side of a square are incommensurable, it follows that lines are infinitely divisible, and that the little points from which the universe was built do not exist.

From that time on, the Pythagorean school entered into decline. It split into two rival factions, one of which buried

itself in ever more abstruse mathematical speculation, while the other attempted to overcome the contradiction by means of ingenious mathematical innovations which laid the basis for the development of the quantitative sciences.